# Electrochemical Characterization of Carbon Nanotube Electrodes and the Development of Chemical/Biosensors

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Carbon nanotubes have unique electronic properties as well as extraordinary adsorption properties due to it large surface area. Many studies have indicated that carbon nanotubes can be used as ultrasensitive sensors for gas molecules. They are also good materials for hydrogen and lithium ion storage. But little is known about the fundamental issues of carbon nanotube electrodes in electrolyte solutions. We report here our studies on the electrochemical characterization of nanotube electrodes with different configurations including single walled nanotube (SWNT) paper, multi-walled nanotube (MWNT) powder, and aligned MWNT towers. These nanotubes were grown under quite different conditions and thus present quite different configurations. Our results have shown that the electrochemical behavior strongly depends on the density, structure, and purity of the carbon nanotube. Purification and functionalization appear to be essential in defining active surface area, charge transfer rate, and adsorption/desorption at the electrode surface. Several methods have been investigated to purify the nanotube surface including strong acid treatment, high temperature thermal treatment, and high temperature steam treatment. Our results have shown dramatic effects of these treatments. We will also report our recent results on functionalizing carbon nanotube electrodes with biomolecules for the purpose to develop ultrasensitive electrochemical biosensors.